



## ROGER D. KAMM

### Curriculum Vitae

#### PERSONAL INFORMATION:

Date of Birth: October 10, 1950  
Office Address: Massachusetts Institute of Technology  
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#### PROFESSIONAL EXPERIENCE:

1998- : Professor of Bioengineering, M.I.T.  
1995- : Lecturer on Medicine, Harvard Medical School  
1994- : Associate Director, Center for Biomedical Engineering, M.I.T.  
1992-1994 : Co-Director: Program in Biomedical Engineering, M.I.T.  
1988- : Professor of Mechanical Engineering, M.I.T.  
1988- : Professor of Health Sciences and Technology, M.I.T. and Harvard University  
1981-1988 : Associate Professor of Mechanical Engineering, M.I.T.  
1986-1987 : Senior Visiting Scientist, University of Cambridge, Department of Applied Mathematics and Theoretical Physics.  
Visiting Fellow, Clare Hall, University of Cambridge.  
1978-1981 : Assistant Professor of Mechanical Engineering, M.I.T.  
1977-1978 : Lecturer and Research Associate in the Department of Mech. Engineering, M.I.T.  
1977 : Instructor, M.I.T.

#### EDUCATION:

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA  
Ph.D. in Mechanical Engineering, May 1977  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA  
S.M. in Mechanical Engineering, August 1973  
NORTHWESTERN UNIVERSITY, Evanston, Illinois  
B.S. in Mechanical Engineering, June 1972

#### HONORS, AWARDS AND SCHOLARSHIPS:

Harry Coulby Scholarship Award (1968-1972)  
NSF Traineeship (1972-1973)  
NIGMS Graduate Fellowship Award (1974-1977)  
Tau Beta Pi, Pi Tau Sigma, Sigma Xi  
Graduate Student Council Teaching Award (1983)  
American Inst. of Medical and Biological Engineering (Founding Fellow) (1993)  
Class of 1960 Award (for development of the Undergraduate Minor in Biomedical Engineering) (1999)  
Everett Moore Baker Memorial Award for Excellence in Undergraduate Teaching (2001)  
Cambridge/MIT Fellow (2001)  
Southwest Mechanics Lecturer (2002)  
Eschbach Distinguished Visiting Scholar Award, Northwestern University (2002)  
Who's Who in America, Who's Who in American Education, Who's Who in Science and Technology

**PROFESSIONAL SOCIETIES:**

American Institute for Medical and Biological Engineering (Founding Fellow)  
American Society of Mechanical Engineering  
Biomedical Engineering Society (Fellow)  
American Physiological Society

**OTHER PROFESSIONAL ACTIVITIES:**

Biomedical Engineering Society; Chair, Awards Committee (1989-91)  
Biomedical Engineering Society; Board of Directors (1994-1997)  
*ASME Journal of Biomechanical Engrg.*, Associate Editor (1990-1996)  
American Heart Association; Research Peer Review Committee (1991-1993)  
NHLBI, NIEHS, NASA, NSF; Review Committees (1988-present)  
*Journal of Fluids and Structures*, Associate Editor (1993-present)  
*Methods in Cell Science*, Editorial Board (1995-present)  
US National Committee on Biomechanics; executive committee (1997-present); secretary (2000-present)  
World Council on Biomechanics (1998-present); vice chair (2002-2006)  
External Review Board, City University of New York, Biomedical Engineering Doctoral Program (1999)  
External Advisory Board, Northwestern University, Dept. of Biomedical Engineering (2000-present)  
Summer Bioengineering Conference, Conference Chair, 2001  
*Biomechanics and Modeling in Mechanobiology*, Editorial Board, 2001-present)  
External Review Board, Pennsylvania State University, Dept. of Biomedical Engineering (2003)  
External Review Board, Duke University, Dept. of Biomedical Engineering (2003)

**RECENT INVITED LECTURES (past year)**

Meeting on Protein Folding and Self-Assembly, Crete, *Self-Assembling Peptide Biomaterials*, July, 2001.  
Georgia Tech, Atlanta, GA, *Cellular mechanics and its role in biological function: Studies in neutrophil margination, deformation, and microstructure*, September, 2001.  
First International Conference on Information in Fluid Science. Sendai, Japan, *Multi-Scale Simulation in Biological Systems*, October, 2001.  
University of Nottingham, UK, *Some intriguing problems in molecular and cellular mechanics*, October, 2001  
University of Cambridge, UK, *Mechanics of the cytoskeleton and other self-assembled protein networks*, October, 2001  
Southwest Mechanics Lecture Series, January, 2002: *Biological Nano-Mechanics: From Cells to Proteins*  
Tulane University, New Orleans, Southern Methodist University, Dallas, University of Houston, Houston,  
University of Oklahoma, Norman  
Northeastern University, *Biomechanics of Cells and Molecules*, January, 2002.  
Rensselaer Polytechnic Institute, *Biological Nano-Mechanics*, February, 2002.  
Florida International University, *Mechanics of Self-Assembling Peptides and their Use as a Biomaterial*, March, 2002.  
University of Vermont, *Cellular Biomechanics – Bridging between Continuum and Molecular Models*, March, 2002.  
Northwestern University (The Eschbach Distinguished Visitor Lecture), *Cellular Biomechanics – Bridging between Continuum and Molecular Models*, April, 2002.  
DuPont TechCon, Delaware, *Self-assembling peptide biomaterials*, May, 2002.  
US National Conference on Theoretical & Applied Mechanics, Blacksburg, Virginia, *Correlations Between Fluid Shear Stress or Tissue Stress and Histological Markers in Advanced Carotid Artery Disease*, June, 2002.

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**RECENT PUBLICATIONS**

- Huang, Y., Doerschuk, C.M., Kamm, R.D. Computational modeling of RBC and neutrophil transit through the pulmonary capillaries. *J Appl Physiol*, 90:545-564, 2001.
- Huang H, Virmani R, Younis H, Burke AP, Kamm RD, Lee RT. The Impact of Calcification Upon the Biomechanical Stability of Atherosclerotic Plaques. *Circulation*, 103:1051-1056, 2001.
- Ozawa, E.T., K.E. Bottom, X. Xiao, and R.D. Kamm. Numerical simulation of enhanced external counterpulsation. *Ann Biomed Eng*. 2001 Apr;29(4):284-97.
- Swartz, MA, Tschumperlin, DJ, Kamm, RD, Drazen, JM. Mechanical stress is communicated between different cell types to elicit matrix remodeling. *PNAS*, 98:6180-5, 2001.
- Huang H, Kamm RD, So PT, Lee RT. Receptor-based differences in human aortic smooth muscle cell membrane stiffness. *Hypertension*. 2001;38:1158-61.
- Heldt, T., Shim, E.B., Kamm, R.D., Mark, R.G. Computational modeling of cardiovascular response to orthostatic stress. *Am J Physiol*, 92(3): 1239-54, 2002.
- Heldt, T., Shim, E.B., Kamm, R.D., Mark, R.G. Computational model of cardiovascular function during orthostatic stress. *Comput Cardiol*, 27: 777-80, 2002.
- Caplan, MR, Schwartzfarb, EM, Zhang, S, Kamm, RD, Lauffenburger, DA. Control of self-assembling oligopeptide matrix formation through systematic variation of amino acid sequence. *Biomaterials*, 23:219-227, 2002.
- Kamm, RD. Cellular fluid mechanics. *Ann Rev Fluid Mech*, 34:211-32, 2002.
- Powers MJ, Domansky K, Mofrad, MRK, Kalezi A, Capitano A, Upadhyaya A, Kurzawski P, Wack KE, Stoltz DB, Kamm RD, Griffith LG. A microfabricated array bioreactor for perfused 3D liver culture. *Biotechnol Bioeng*, 78:257-269, 2002.
- McKay, KO, Wiggs, BR, Pare, PD, Kamm, RD. The zero stress state of intra- and extraparenchymal airways from human, pig, rabbit and sheep lung. *J Appl Physiol*, 92(3): 1239-54, 2002.
- Caplan MR, Schwartzfarb EM, Zhang S, Kamm RD and Lauffenburger DA. Effects of systematic variation of amino acid sequence on the mechanical properties of a self-assembling, oligopeptide biomaterial. *J Biomaterials Sci*, 13(3): 225-236, 2002.
- Xiao X, Ozawa ET, Hwang Y, Kamm RD. Model-based assessment of cardiovascular health from noninvasive measurements. *Ann Biomed Eng*, 30(5):612-23, 2002.
- Dai G, Tsukarov O, Chen M, Gertler JP, Kamm RD. Nitric oxide production by cultured human vein endothelial cells: response to in vitro simulation of external pneumatic compression. *Am J Physiol Heart Circ Physiol*. 282(6):H2066-75, 2002.
- Marini DM, Hwang W, Lauffenburger DA, Zhang S, Kamm RD. Left-handed helical ribbon intermediates in the self-assembly of a  $\beta$ -sheet peptide. *Nano Letters*, 2(4): 295-299, 2002.
- Hrousis CA, Wiggs BJR, Drazen JM, Parks DM, Kamm RD. Mucosal folding in biologic vessels. *J Biomech Eng*, 124:334-341, 2002.
- Napadow V, Kamm RD, Gilbert J. A biomechanical model of sagittal tongue bending. *J Biomech Eng*, 124(5): 547-556, 2002.
- Shim, EB, Kamm RD. Numerical simulation of steady flow in a compliant tube or channel with tapered wall thickness. *J Fluids Structures*, in press.
- Bathe, M. Shirai, A. Doerschuk, CM, Kamm, RD. Neutrophil transit times through pulmonary capillaries: The effects of capillary geometry and fMLP-stimulation. *Biophys. J.*, in press, 2002.
- Williamson SD, Lam Y, Younis HF, Huang H, Patel S, Kaazempur-Mofrad MR, Kamm RD. On the sensitivity of wall stresses in diseased arteries to variable material properties, *J Biomech Eng*, in press.
- Hwang W, Marini DM, Kamm RD, Zhang S. Supramolecular structure of helical ribbons self-assembled from a  $\beta$ -sheet peptide. *J Chem Phys*, in press.

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### RECENT INDUSTRIAL INTERACTIONS (past two years)

APEX Medical (Scientific Advisory Board)  
Mitsubishi Electric (medical products) (Consultant)  
Percardia, Inc. (Consultant, Scientific Advisory Board)  
Cardiovascular Technologies (Co-founder)  
EmboLytic Protection, Inc. (Consultant, Scientific Advisory Board)  
STD Manufacturing (Consultant)  
Aircast, Inc. (Research sponsor)  
Hale and Dorr (Consultant)  
MyoMend, Inc. (Scientific Advisory Board)

### RESEARCH INTERESTS

#### *Cell mechanics and mechanotransduction*

Cytoskeletal mechanics and computational modeling of cell deformations and force transmission through the cell.  
Measurements of intracellular strain fields due to forces applied by adherent beads.  
Transduction of mechanical signals by protein conformational changes.

#### *Cardiovascular fluid dynamics*

Numerical simulation of cardiovascular flows including the mechanics of the normal and pathologic arterial wall, heart assist and total artificial heart, flows induced by external compression, external pneumatic compression and external cardiac assist.  
The effects on endothelial function of shear stress in terms of altering fibrinolytic tendencies, inducing the adhesion of monocytes in the vicinity of an atherosclerotic lesion, and the stimulation of macrophages by mechanical stress of the arterial wall.

#### *Biomaterials*

Development of functionalized scaffold for tissue engineering based on self-assembled peptide hydrogels.  
Design of peptide matrices for studies of angiogenesis and cardiac tissue engineering.

#### *Respiratory mechanics and fluid dynamics*

Studies of the airway wall mechanics during bronchoconstriction in normal and asthmatic airways and the potential role of stress-induced remodeling.  
Modeling of the flow of red blood cells and neutrophils through the lung, and the process by which neutrophils tend to accumulate in the pulmonary vasculature.

#### *Biomaterials*

Development of new oligopeptide biomaterials that self-assemble under physiologic conditions and can be used as scaffolds for tissue implants and drug delivery.  
Studies into the relationship between peptide sequence and the process of self-assembly.

**CURRENT RESEARCH SUPPORT**

<u>Agency</u>	<u>Grant Title</u>	<u>Period Covered</u>
NHLBI	<i>Numerical analysis of flow and tissue deformation in the atherosclerotic artery</i>	10/1/98 – 9/31/02
NASA	<i>Computational Models of the Cardiovascular System</i>	10/1/01 – 9/31/03
Aircast	<i>Angiogenesis by External Compression</i>	9/1/95 - continuing
DuPont/MIT Alliance	<i>Micromechanical Properties of Biopolymers: New Measurement Instrumentation with Application to Self-Assembling Peptide Nanofiber Materials</i>	9/1/00 - 8/31/02
NHLBI	<i>Mechanotransduction in Cardiovascular Cells (PPG)</i>	9/28/01-9/31/06
NHLBI	<i>In-Situ Measurement of Plaque Biomechanical Properties</i>	3/1/02-2/28/-05

**BRIEF NARRATIVE AND CURRENT INTERESTS**

Roger D. Kamm is author or co-author of over 110 papers in refereed journals in the fields of cardiovascular, respiratory, and ocular physiology and engineering. Recent interests have focused on cardiovascular issues with an aim toward melding computational approaches with cell and molecular biology. Most of Kamm's research is performed with support from four current NIH grants, with additional support coming from NASA, DARPA, an industrial consortium, and two industrial sponsors.

Dr. Kamm holds 4 patents in the medical device field with 2 patents pending. He co-founded CardioVascular Technologies, Inc., which emphasized new approaches to non-invasive or minimally-invasive treatment of vascular disease. He maintains an active consulting practice in the broad area of biomedical devices and the use of computational modeling in medicine.

Dr. Kamm has also been actively instrumental in the education of students in bioengineering and biomechanics. He was one of three faculty to develop the Undergraduate Minor in Biomedical Engineering (1995) at MIT, and chaired the committee to initiate the Master of Engineering in Biomedical Engineering (2000). With two colleagues, he developed a new subject in *Molecular, Cellular and Tissue Biomechanics* for which he is currently writing a textbook with sponsorship of the Whitaker Foundation. He was the recipient of the Everett Moore Baker Memorial Award, the highest, Institute-wide teaching award selected by students.